The AML Project

Since 1990 NIST has continually reassessed its program and building needs. In 1992, NIST proposed a 10-year plan to upgrade its facilities to the high-performance condition necessary to efficiently provide U.S. industry and science with world-class measurements. Throughout this planning process, NIST has provided substantial information to document its needs—Appendix B contains a list of the key documents prepared to measure and quantify NIST's capital asset needs, estimate their costs, and set out timelines for their fulfillment.

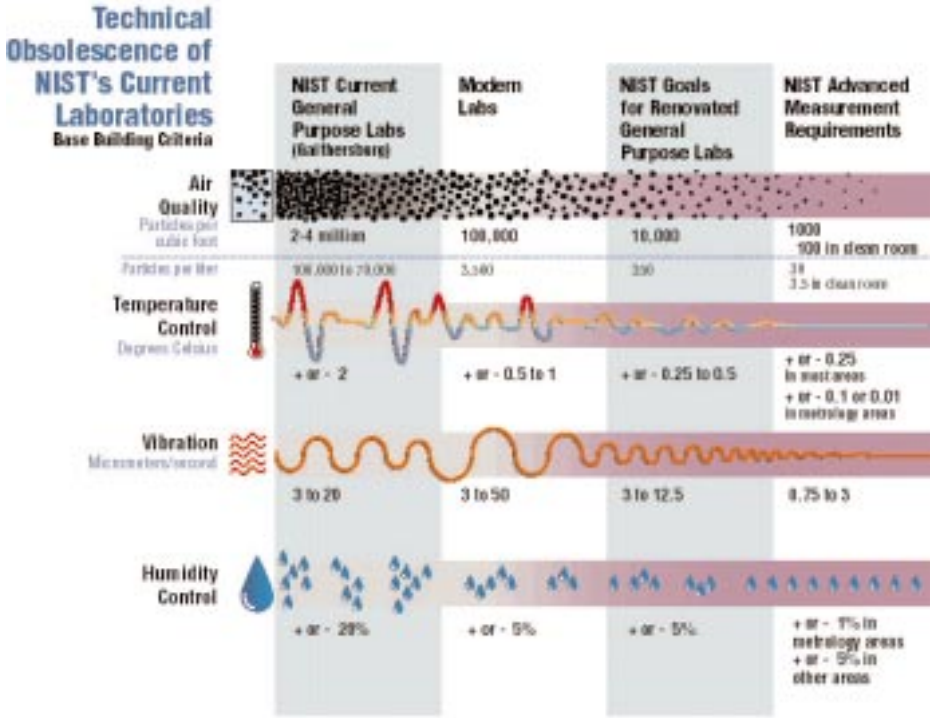
The Advanced Measurement Laboratory (AML) has been a key element of NIST's facilities plan since 1992, and a suite of advanced cleanrooms is an essential component of the AML. This section briefly summarizes the background of this project in order to provide context for the cleanroom discussion.

NIST has done everything possible to reduce costs of its facilities improvement plans, particularly that of the largest single component, the AML.

The current plan does not include space for research activities that NIST's design and engineering consultants judged likely could be accommodated at comparable cost in renovated general-purpose laboratory space. The programs that remain can be accommodated only in AML-grade space. Among these programs are several that require facilities with characteristics commonly associated with cleanrooms at the higher standards of cleanliness.

The most recent of the needs assessment studies was completed in 1997 as part of the process NIST used to develop its FY 1999 budget proposal. In this new study Smith, Hinchman & Grylls Association Inc (SHG) conducted a "retrace" of its comprehensive 1992 facilities needs assessment. SHG's 1997 study documented the severe technical obsolescence and deteriorating conditions of NIST's facilities. They found that "67 percent of NIST's laboratories fail to meet system performance levels required by current scientific and engineering programs" and identified numerous performance deficiencies in terms of vibration isolation, temperature and humidity control, air cleanliness, and power quality. The chart below illustrates the technical obsolescence of NIST's current laboratories that the AML was designed partially to address.

Booz-Allen & Hamilton Inc. completed an economic analysis of facilities investment alternatives in June 1997 (BAH). BAH found that, "Without intervention, the performance deterioration caused by the facilities inadequacies will impede, if not invalidate, NIST's ability to maintain standards in weights and measures, and to facilitate the development and application of new technology and the advancement of basic science." The estimated cost of the AML, $218.3 million, also was validated by the BAH study. This cost



cannot be reduced any further without significantly impacting the function of the AML.

Both the SHG retrace study and the BAH business case analysis recommended that NIST build the Advanced Measurement Laboratory, including the cleanroom component, without delay.

The AML will include five different sections joined by a central corridor that connects them to the current Metrology Building. There are two different metrology sections in the proposed AML. "Metrology East" includes those areas of atomic physics, mass measurements, or other research that require excellent isolation from vibration sources as well as good air quality and temperature and humidity control. The "Metrology West" section will include NIST research and calibrations using coordinate measuring machines and other metrology instruments that need good vibration isolation and temperature control but that also create some vibration due to the fact that parts of the machines must move while measuring artifacts.

The AML also will include two sections of Instrument Laboratories. These will include one floor of laboratory space, above ground, on well-isolated concrete slabs on grade for research using, for example, electron microscopes and laser/optic equipment with stringent requirements for control of vibration, temperature, humidity, and air quality. Finally, the AML also will include a cleanroom section that offers approximately 12,000 nsf of aboveground laboratory space. It will be similar to those certified as class 100 (less than 3.5 particles per liter) and has been designed to be upgradable to class 10 or better as needed.

The exacting requirements that this proposed facility presents include:

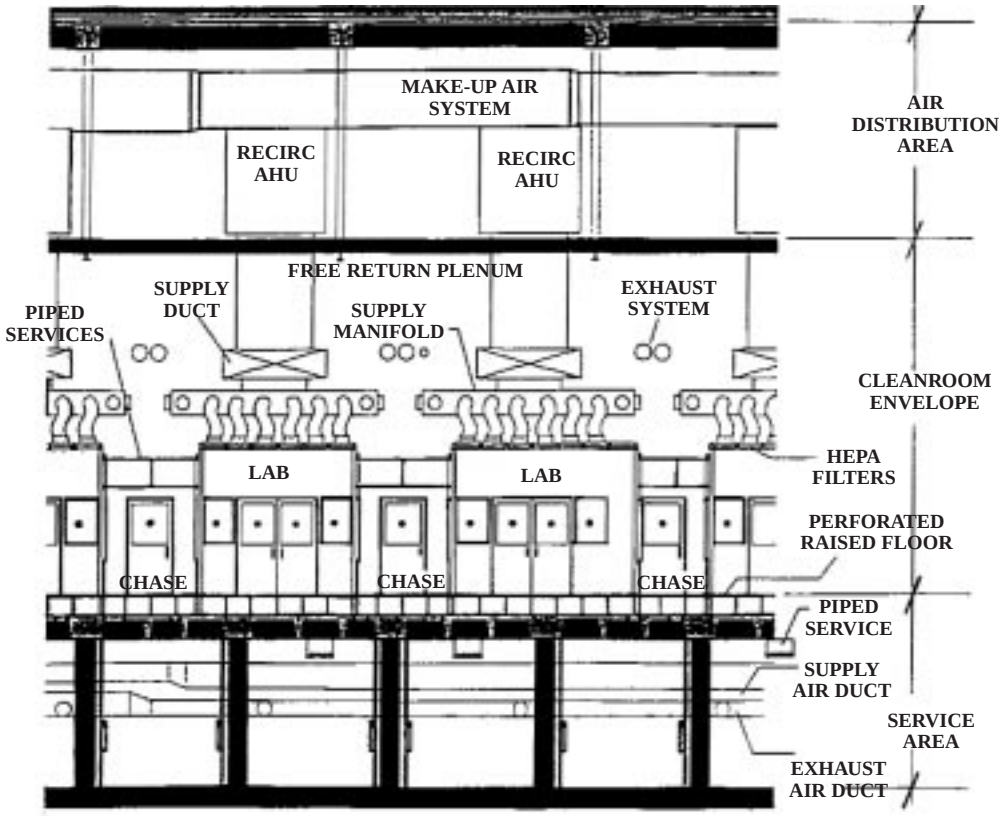
- Extremely low levels of vibration (a velocity amplitude of 3 micrometers per second or less).
- Large volumes of air changes to produce the necessary temperature control of +/- 0.25 degree Celsius or better.
- Extremely good cleanliness (1,000 particles per cubic foot in most areas, 100 in the cleanroom) that can be upgraded as needs arise.
- Excellent humidity control (to +/- 1 percent in advanced metrology areas).

It is not economically feasible to retrofit existing space to meet these requirements. Structural limitations of the existing general-purpose laboratories effectively prevent achieving the necessary headroom, flexibility, and overall performance levels of an AML-grade laboratory. (See cleanroom cross section on next page.) For example, while some improvement in vibration levels is possible through isolation of mechanical equipment in a retrofitted building, the exceptionally low levels required for NIST's atomic-based measurements require a building specifically designed to achieve this goal.

Completion of the AML will result in a little less than one quarter of all NIST's laboratory space meeting the criteria of modern laboratories or better. If the failure rate of the remaining laboratories can be maintained at the 67 percent level or below, the overall failure rate of NIST's facilities might be expected to decrease from the present 67 percent in the most recent SHG study to somewhere in the vicinity of 50 percent.

The AML design was completed in 1996 at a cost of $17 million. A total of $203.3 million is needed for construction. NIST has received $108.3 million of this amount in previous appropriations, and the President's FY 2000 budget requests $95 million. An additional $15 million will be requested in FY 2001 for fit up, relocation, and communication costs. Since the design was completed in 1996, it requires some revision to take into account certain updated safety features, code requirements, and some minor research-driven changes. The history, purpose and nature of the AML are explained in more detail in an addendum (Facilities Improvement Plan, Addendum 1) sent to Congress in June 1998. An updated report on NIST's plan for the AML was prepared to accompany the President's FY 2000 budget request. See *NIST Advanced Measurement Laboratory and Maintenance Priorities Update,* February 1999.

Cross Section of Typical Advanced Cleanroom



Shown above is a cross section of a typical advanced cleanroom of the type planned for the Advanced Measurement Laboratory. The cleanroom envelope has a floor-to-ceiling distance of about 8 meters (for scale note the doorways in the labs), and the entire structure has a vertical dimension of about 18 meters. This kind of facility cannot be retrofitted into any of NIST's existing buildings at either site.